Sidak/Teece
Declaration

BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
1998 Biennial Regulatory Review–	)	WT Docket No. 98-205
Spectrum Aggregation Limits	)	
for Wireless Telecommunications Carriers	)	

DECLARATION OF J. GREGORY SIDAK AND DAVID J. TEECE

CONTENTS

J. Gregory Sidak and David J. Teece declare as follows:

EXECUTIVE SUMMARY

1. By regulation, the Commission has limited to 45 MHz the amount of commercial mobile radio services (CMRS) spectrum that may be licensed to a single entity within a particular geographic area.[1] As the Commission states in its NPRM in this proceeding, "a single entity may acquire attributable interests in the licenses of broadband Personal Communications Service (PCS), cellular, and Specialized Mobile Radio (SMR) services that cumulatively do not exceed 45 MHz of

1. 47 C.F.R. § 20.6.

spectrum within the same geographic area."[2] We have been asked by GTE Service Corporation to determine the economic impact of the Commission's spectrum cap policy. We conclude that the spectrum cap should be abolished and that the Commission should rely instead on general antitrust enforcement mechanisms to protect competition in wireless markets.

2. We employ decision-theoretic analysis to show that the expected costs of retaining the 45 MHz spectrum cap exceed the expected costs of removing it. The expected costs of removing the spectrum cap are negligible. The probability of either monopolization by a single firm or collusive pricing by a group of firms is near zero due to the growing tendency of carriers to adopt nationwide pricing plans and because capacity is a function of both spectrum *and* equipment. In contrast, the expected costs of retaining the spectrum cap are substantial as wireless services evolve from narrowband applications to broadband applications. The probability that a single carrier would use more than 45 MHz is nontrivial, because the growth in demand due to consumers' desire for bundled service offerings and the invasion of wireless carriers into fixed communications markets will together severely burden existing networks. In short, a cost-benefit analysis demonstrates that the Commission should abolish the spectrum cap because the expected costs of retaining the spectrum cap vastly exceed the expected costs of removing it.

3. The Commission's retention of the 45 MHz spectrum cap would thwart one of the

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2. Notice of Proposed Rulemaking, in the Matter of 1998 Biennial Regulatory Review--Spectrum Aggregation Limits for Wireless Telecommunications Carriers, WT Docket No. 98-205, Date Adopted: Nov. 19, 1998, at ¶ 2 [hereinafter *NPRM*].

principal functions served by market forces—namely, to produce and reveal information. In the event that the Commission fails to deter a single carrier, or group of carriers acting collusively, from exercising market power, the Commission at least becomes aware of the problem and can take steps to remedy the harm to the public interest. In contrast, with the cap in place, it is possible that the Commission would never learn that it was preventing the optimal input selection of wireless firms. Such information is extremely valuable for the Commission to have at its disposal, as it would assist the agency in redefining its spectrum allocation policy in the manner most conducive to the public interest.

4. The remainder of our declaration is organized as follows. In section I, we explain our decision-theoretic rule for determining whether the Commission should remove the spectrum cap. In section II, we estimate the expected costs of removing the cap and describe the magnitude of those costs in qualitative terms. In section III, we present the same analysis with respect to the expected costs of retaining the cap. We conclude that the Commission's retention of the 45 MHz CMRS spectrum cap would not serve the public interest.

I. AN APPLICATION OF THE DECISION-THEORETIC FRAMEWORK

A. Formulating the Decision Rule

5. Decision theory is a branch of the social sciences that explores the issue of making optimal decisions in complex environments.[3] We employ decision-theoretic analysis to show that the expected cost of retaining the 45 MHz spectrum cap exceeds the expected cost of removing it. The expected cost of any random event is the product of the probability of the event and the associated cost given that the event occurred. For example, if the probability of a successful robbery with the front door open is 10 percent and the valuables in the home are worth $10,000, then the expected loss from leaving the door unlocked is $1,000 = .10 x $10,000.

6. The Commission should compare the frequency and severity of the errors that might arise under the existing policy regime (the 45 MHz spectrum cap) with the frequency and severity of the errors that might arise under the alternative policy regime (abandonment of the cap). We believe that such an approach is consistent with Commission's first principle for deciding whether to eliminate the spectrum cap—"that trusting in the operation of market forces generally better serves the public interest than regulation."[4]

7. The Commission must consider that any spectrum cap decision unavoidably will entail two kinds of expected social costs. The first is the loss in consumer welfare resulting from the failure to prevent the successful exercise of market power by a single firm, or a group of

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3. For a general explanation of the decision-theoretic framework, see JEAN-JACQUES LAFFONT, THE ECONOMICS OF UNCERTAINTY AND INFORMATION (MIT Press 1995); DAVID M. KREPS, A COURSE IN MICROECONOMIC THEORY 71-120 (Princeton University Press 1990).

firms acting in explicit or tacit collusion, plus the associated enforcement costs of remedying that loss in the absence of the cap. The second is the efficiency loss that would ensue if at least one carrier would have chosen to use, for procompetitive or efficiency-enhancing reasons, more than 45 MHz of spectrum in the absence of the cap, plus the associated enforcement costs of remedying that loss in the presence of the cap.

8. The Commission should abolish the cap if the expected costs of retaining the cap exceed the expected costs of removing it. This principle is simply a variant on the argument, familiar in antitrust policy, that a liability rule should minimize the combined costs of false positives (Type I errors), false negatives (Type II errors), and the costs of administration.[5] Eminent economists such as Kenneth J. Arrow, William J. Baumol, and Paul W. MacAvoy have extended that economic reasoning to the optimal design of telecommunications regulation.[6] A Type I error is the failure of the Commission to deter a *harmful* event—namely, the loss in consumer welfare resulting from monopolization by a single firm of a particular geographic region or collusion by a group of firms in that geographic region. In contrast, a Type II error is

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4. *NPRM, supra* note 2, at ¶ 5.

5. *See* Paul L. Joskow & Alvin K. Klevorick, *A Framework for Analyzing Predatory Pricing Policy*, 89 YALE L.J. 213, 223 (1979); Frank H. Easterbrook, *Predatory Strategies and Counterstrategies*, 48 U. CHI. L. REV. 263, 318–19 (1981); Richard C. Schmalensee, *On the Use of Economic Models in Antitrust: The* ReaLemon *Case*, 127 U. PA. L. REV. 994, 1018–19 n.98 (1979); J. Gregory Sidak, *Debunking Predatory Innovation*, 83 COLUM. L. REV. 1121, 1144–45 (1983). These scholars in law and economics in turn borrowed the construct of Type I and Type II errors from hypothesis testing in statistics. *See, e.g.*, PAUL G. HOEL, INTRODUCTION TO MATHEMATICAL STATISTICS 108–09 (John Wiley & Sons, Inc. 4th ed. 1971).

6. WILLIAM J. BAUMOL & J. GREGORY SIDAK, TOWARD COMPETITION IN LOCAL TELEPHONY 131–32 (MIT Press & AEI Press 1994); PAUL W. MACAVOY, THE FAILURE OF ANTITRUST AND REGULATION TO ESTABLISH COMPETITION IN MARKETS FOR LONG-DISTANCE TELEPHONE SERVICES ch. 6 (MIT Press & AEI Press 1996); Kenneth J. Arrow, Dennis W. Carlton & Hal S. Sider, *The Competitive Effects of Line-of-business Restrictions in Telecommunications*, 16 MANAGERIAL & DECISION ECON. 301, 305 (1995) ("The goal of public policy in telecommunications should not be simply to minimize potential regulatory problems but instead to maximize net benefits to society."); J. Gregory Sidak, *Telecommunications in Jericho*, 81 CALIF. L. REV. 1209, 1216–17 (1993).

the failure of the Commission to allow a *beneficial* event—namely, the efficiency gain that would be realized when a single carrier uses more than 45 MHz of spectrum for a procompetitive or efficiency-enhancing purpose.

9. It is important to note that the Commission's problem could just as easily be cast as maximizing the expected gains from the two types of fortuitous events. The expected loss associated with the Type II error (namely, the loss in productive efficiencies due the increase in the minimum efficient scale) is equivalent to the productivity gains that might occur should the cap be removed. Likewise, the expected loss associated with the Type I error (namely, the loss in consumer welfare due to monopolization of or collusion in a geographic region) is equivalent to the gain in consumer welfare that might occur should the cap be retained.

B. Calculating the Expected Costs of Removing or Retaining the Spectrum Cap

10. The expected cost of removing the spectrum cap equals the product of (1) the probability that a large carrier or a cartel of carriers will exert market power within a particular region and (2) the sum of the associated loss in consumer welfare and the enforcement costs of remedying that loss. For purposes of this proceeding, we designate as a Type I error the event in which government policies would fail to deter a single firm, or a group of firms acting collusively, from exercising market power within a particular region after the Commission's removal of the 45 MHz spectrum cap. The expected cost of keeping the spectrum cap is the product of (1) the probability that the minimum efficient scale for at least one firm exceeds the spectrum cap and (2) the sum of the efficiency losses and the enforcement costs of remedying those efficiency losses. For purposes of this proceeding, we designate as a Type II error the event

in which the Commission's continued enforcement of the spectrum cap would prevent at least one firm from achieving a minimum efficient scale that exceeded the 45 MHz spectrum cap.

11. It may be useful to formalize the conceptual process by which the Commission would optimally define its spectrum-cap rule. The proper goal should be to maximize consumer welfare, which can be achieved at an operational level if the Commission seeks to minimize the total costs C:

$$C = \begin{cases} p\left(L_p + A_p\right) & \textit{in the event of a Type I error} \\ q\left(L_q + A_q\right) & \textit{in the event of a Type II error} \end{cases}$$

where

p = the probability that the Commission fails to deter a single carrier, or a group of carriers acting collusively, from exercising market power (that is, the probability of a Type I error)

L_p = the consumer welfare loss associated with a Type I error

A_p = the enforcement costs of remedying damages in the event that a single carrier or a group of carriers exerts market power

q = the probability that at least one carrier would have chosen to use more than 45 MHz of spectrum (that is, the probability of a Type II error)

L_q = the efficiency loss associated the Type II error

A_q = the enforcement costs of remedying damages in the event of a Type II error

In the following sections we explore in qualitative terms the magnitudes of the probability of the Type I and Type II errors and their associated social costs.

II. THE EXPECTED COSTS OF REMOVING THE SPECTRUM CAP ARE SMALL

A. The Probability That the Commission Fails to Deter a Single Carrier, or a Group of Carriers Acting Collusively, from Exercising Market Power Is Small

12. The probability of a Type I error (that is, the probability that, once the cap is removed, the Commission fails to deter a single carrier, or a group of carriers acting collusively, from exercising market power) is close to zero. First, competition in wireless services is robust and is expected to strengthen. Second, a rational firm must consider the pricing reactions of its rivals while contemplating any price increase. Given the growing tendency of carriers to adopt nationwide pricing plans, it is highly unlikely that such a price increase would induce competitors to raise prices in a given location. Thus, any attempt by a firm to monopolize wireless services in a particular region would cause its revenues to fall, because existing customers would flock to the lower-priced national carriers. Third, a rational carrier would recognize that even a smaller rival in the same region could absorb virtually all of the first carrier's traffic given the current technology. Fourth, because capacity is a function of both spectrum and equipment, any exercise of market power would require virtual monopolization of both the spectrum and telecommunications equipment markets.[7] Given the independent ownership of telecommunications equipment and services firms, this event is highly doubtful. Fifth, ease of entry into the wireless voice and data services market undermines the ability of any single firm, or any group of firms acting collusively, to exercise market power. Sixth, the durable

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7. This presumes that other carriers in the region have at lease some spectrum.

nature of spectrum would render any attempted monopolization or collusion futile. Seventh, warehousing of spectrum is not a feasible means to monopolize the wireless services industry. We now consider each of these seven factors.[8]

1. Competition in the Wireless Services Industry Is Robust

13. In an attempt to spur competition in the U.S. wireless industry, the Commission in the mid-1990s auctioned spectrum for a second generation of wireless service known as personal communication services (PCS). The first major broadband PCS auction (the "A & B Auction") closed on March 13, 1995.[9] The second (the "C Auction") and third (the "D, E & F Auction") broadband PCS auctions closed on May 5, 1995, and August 26, 1996, respectively.[10] The amount of spectrum in each auction varies from 10 MHz in the D, E, and F bands to 30 MHz in the A and B bands.

14. At the time of the spectrum auctions, the Commission imposed several constraints on the ability of firms to aggregate spectrum in a given geographic region. First, the Commission created a 45 MHz spectrum cap on any combination of broadband Personal Communication Services (PCS), Specialized Mobile Radio Service (SMR), and cellular licenses.[11] The

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8. The likelihood of a Type I error with respect to collusion is low not only for all the reasons that we will address, but also for the absence of familiar predisposing characteristics for successful collusion—such as uniform prices, penalties for price discounts, advance notices of price change, information exchanges, and delivered pricing. *See* DENNIS W. CARLTON & JEFFREY M. PERLOFF, MODERN INDUSTRIAL ORGANIZATION 416-17 (Harper Collins College Publishers 2nd ed. 1994); RICHARD A. POSNER & FRANK H. EASTERBROOK, ANTITRUST: CASES, ECONOMIC NOTES, AND OTHER MATERIALS 336-38 (West Publishing Co. 2nd ed. 1981).

8. http://www.fcc.gov/auctions

9. *Id.*

11. Third Memorandum Opinion and Order, FCC 94-265, GEN Docket No. 90-314, Date Adopted: Oct. 19, 1994.

Commission justified the cap as a means of stabilizing the marketplace without sacrificing the benefits of procompetitive and efficiency-enhancing aggregation. If a carrier were to aggregate sufficient amounts of spectrum, the Commission reasoned, it would be possible for the carrier to "exclude efficient competitors, to reduce the quantity or quality of services provided, or to increase prices to the detriment of consumers."[12]

15. In addition to the spectrum cap, the Commission imposed other constraints on the ability of a single carrier to aggregate spectrum. For example, the Commission placed restrictions on the ability of cellular carriers to bid in the PCS auctions.[13] The Commission also set aside two entrepreneurs' blocks, C and F, to ensure that "designated entities" had an opportunity to participate in the provision of broadband PCS.[14] The designated-entities set-asides, cellular PCS cross-ownership restrictions, and spectrum cap represented a strong effort on the part of the Commission to diversify ownership in the wireless industry.

16. Aggregation rules, like the spectrum cap, are no longer necessary, as competition in the wireless industry is robust. Before the auctions, no region in the country was served by more than three wireless carriers.[15] As early as June of 1998, 273 of 493 basic trading areas

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12. *NPRM, supra* note 2, at 10.

13. In the Further Order on Reconsideration, the Commission "retained [its] cellular attribution threshold of 20 percent equity ownership of a cellular licensee and [its] service area overlap test of 10 percent of the population of the relevant PCS market, so that an entity wishing to participate fully in PCS generally may not own more than 20 percent of a cellular license, and not more than 5 percent of a PCS license(s)...." Third Memorandum Opinion and Order, FCC 94-265, GEN Docket No. 90-314, Date Adopted: Oct. 19, 1994 at ¶ 17.

14. Fifth Memorandum Opinion and Order, FCC 94-285, PP Docket No. 93-253, Date Adopted: Nov. 10, 1994.

15. This includes the two cellular carriers and potentially Nextel, which began offering digital mobile telephone service in August 1993. *See* Third Annual CMRS Competition Report, In the Matter of Implementation

(BTAs), representing 87 percent of the U.S. population, were served by three or more competitors.[16] Four or more carriers served 135 BTAs, representing 69 percent of the population.[17]

17. In addition to this actual competition, potential competition is substantial. The number of competitors will continue to rise as winners of the D, E & F Auction enter the industry. For example, Sprint launched service in Jacksonville, Tampa, and St. Petersburg in 1998 and is planning to introduce service in Atlanta, Chicago, Cincinnati, Houston, Richmond, and Orlando early 1999.[18] In Chicago and Houston, Sprint represents the sixth wireless carrier. Local exchange carriers are also entering as wireless providers in areas where they have a wireline presence. BellSouth entered Tampa-St. Petersburg in October 1998, with expansion planned into the neighboring counties.[19] U S WEST has entered Phoenix, Denver, and Portland, Oregon, and is planning to expand into the surrounding areas north through Seattle.[20]

18. Finally, the entrance of PCS carriers is placing significant downward pressure on wireless prices. Industry analysts expect prices of cellular service to continue to fall as PCS firms continue to start operations. Indeed, the expected rate of decline in cellular prices has accelerated over the last few years. Figure 1 shows forecasts of cellular service prices (in constant dollars of revenue per minute of use) prepared by Donaldson, Lufkin & Jenrette ("DLJ"). DLJ expects

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of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, FCC 98-91, at 16 (adopted May 14, 1998) [hereinafter *Third Annual Report*], for a complete description of Nextel's development.

15. *Id.* at 19.

17. *Id.*

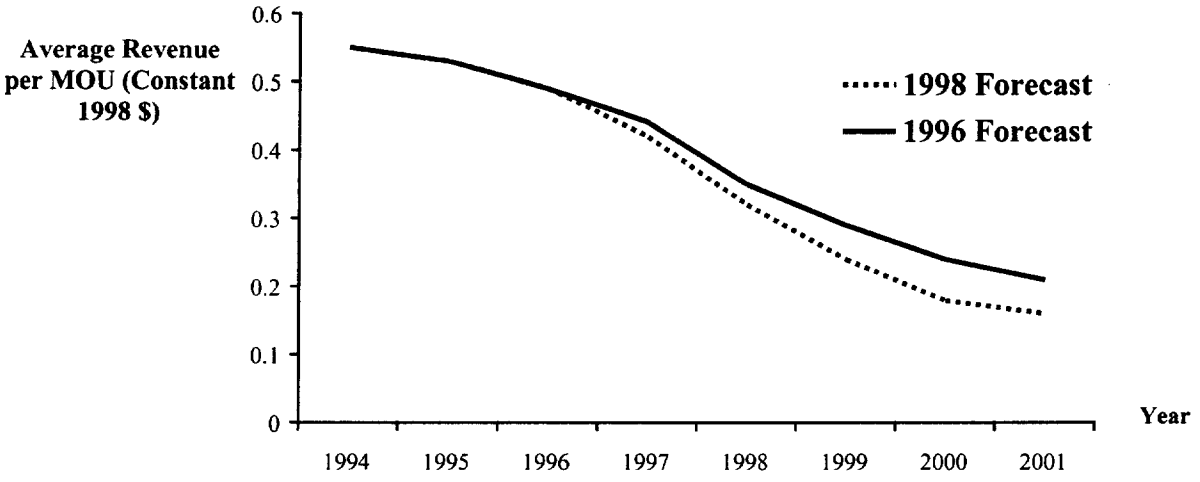
18. http://www.sprintpcs.com

19. http://www.bellsouthcorp.com/proactive/documents/render/21882.vtml

20. http://www.uswest.com/advancedpcs/coverage.shtml

cellular prices to continue declining by substantial amounts over the next several years.[21] A comparison of DLJ's 1996 and 1998 forecasts shows that cellular prices have fallen even more rapidly than DLJ expected just two years ago.[22]

FIGURE 1: DECLINE IN FORECAST PRICES FOR CELLULAR SERVICE



Source: DONALDSON, LUFKIN & JENRETTE, THE WIRELESS COMMUNICATIONS INDUSTRY 16 (summer 1996 ed.); DONALDSON, LUFKIN & JENRETTE, THE WIRELESS COMMUNICATIONS INDUSTRY 20 (spring 1998 ed.).

2. Nationwide Carriers Are Constrained in Their Ability to Selectively Raise Prices in Particular Regions

19 The geographic scope of markets has increased over time due to an increasing degree of integration between regional markets and to the emergence of national carriers and pricing plans. Carriers have attempted to create a nationwide footprint through purchases of

21. DONALDSON, LUFKIN & JENRETTE, THE WIRELESS COMMUNICATIONS INDUSTRY, Spring 1998, at 20.
22. Appendix A shows cellular prices for the top fifty MSAs in 1996 and 1998. In almost every case, prices

complementary spectrum, acquisitions of complementary firms, joint ventures, and leasing agreements. With a virtually nationwide footprint in place, carriers have launched single-rate plans to lure customers from competing cellular services and even wireline services. The Commission has identified footprint expansion as a major operational trend in the wireless industry.[23] As evidence in support of this trend, the Commission in May 1998 cited the announcement by SBC Communications to acquire Southern New England Telecommunications Corp. and its cellular licenses and Nextel's acquisition of Pittencrieff, the second largest SMR operator at the time.[24]

20. Examples of nationwide pricing are abundant. Nextel, a "maverick" firm, introduced a "no roaming" plan in January 1997.[25] Established providers have responded to Nextel's innovation. Sprint launched its national plan in early 1998, [26] and AT&T Wireless followed suit in May 1998.[27] Bell Atlantic and AirTouch began to offer single-rate plans in September 1998.[28] The presence of such nationally advertised "one-rate" plans substantially reduces (or eliminates) any concern that carriers could amass spectrum in an effort to extract monopoly rents in any given region.

21. Any rational firm considering a price increase must contemplate the response of its rivals in the same region. Given the high likelihood that at least one of those rivals employs a nationwide pricing plan, the expected payoff of any price increase by a local carrier will always

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fell substantially over the two-year period.

23. *Third Annual Report*, *supra* note 14.
24. *Id.* at 17.
25. *Nextel Launches Florida and Ohio Valley Markets*, PR NEWSWIRE (July 31, 1997).
26. Elizabeth Douglass, *Telecom Talk 'Roaming' Era Nears Its End*, L.A. TIMES, Oct. 5, 1998, at B1.
27. *Id.*

be less than the expected payoff under no price increase. A nationwide carrier would be insensitive to local changes in prices. Thus, any unilateral price increase would induce the immediate exit of customers to the lower-priced nationwide carrier.[29] Recognizing that futile outcome, the firm would not attempt the localized price increase.

3. Capacity Is a Function of Both Spectrum and Equipment

22. It is erroneous on economic grounds to purport to measure the capacity of a wireless firm on the basis of spectrum alone. Rather, capacity is a function of at least two variables—spectrum *and* equipment. It is natural to consider the tradeoff between spectrum and equipment while keeping a constant level of capacity. Thus, a single firm attempting to monopolize a particular region, or any group of firms colluding to raise prices there, would have to dominate both the available supply of spectrum and the available supply of capacity-expanding equipment.[30] Table 1 shows that the wireless telecommunications equipment manufacturers have substantial market capitalizations. It is highly improbable that a single carrier, or even a cartel of carriers, could coordinate arrangements with all equipment providers so that a smaller rival in the same location could not augment its capacity through equipment upgrades.

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28. *Id.*

29. This example assumes that the price of the local carrier is originally greater than or equal to the price of the nationwide carrier. Even if the opposite were true, consumers will be inclined to drop the local service because the product offering of the nationwide carrier is superior.

30. It is important to note that there is no cross-ownership between the major wireless service carriers and telecommunications equipment firms.

TABLE 1: WIRELESS EQUIPMENT MANUFACTURERS AND MARKET CAPITALIZATION

Company	Market Capitalization (U.S. $ B)	Profile
Glenayre Technologies	0.3	Manufactures paging infrastructure and devices, enhanced services for mobile and fixed networks, spread spectrum and microwave radio and equipment.
Harris Communications	3.1	Manufactures microwave radio systems and wireless local loop telephony systems.
Andrew Corporation	1.7	Manufactures base station antennas, antenna, microwave and wireless systems, microwave transmission lines.
Scientific-Atlanta, Inc.	2.1	Manufactures advanced terrestrial and satellite network products and systems to deliver voice, data and video communications services
Titan Corporation	0.2	Manufactures satellite communications systems, information technology solutions, and sterilization systems and services for commercial and government customers worldwide
Lucent Technologies	145.5	Manufactures wireless networks, third generation systems, and services systems and software which enable network operators and other service providers to provide wireless access, local, long distance and international voice, data and video services and cable service.
Nortel	37.4	Designs, develops, manufactures, markets, sells, finances, installs and services fully digital telecommunications systems, including phones, switches and software.
Ericsson	44.5	Develops and manufactures systems and terminals for private radio systems and customer-specific mobile data solutions for GSM and Mobitex, wireless handsets and accessories, switches and various wireless systems for network operators.
Nokia	83.5	Supplies telecommunications systems and equipment. Core businesses include the development, manufacture and delivery of operator-driven infrastructure solutions and end-user-driven mobile phones.
Qualcomm	4.5	Designs, develops, manufactures, markets, licenses, and operates digital wireless communications, infrastructure and subscriber products, designs and services.
Alcatel	19.1	Manufactures wireless equipment and systems, including wireless access systems, mobile networks, microwave radio etc.
Tellabs	16.9	Manufactures many wireless solutions such as digital trunk translators and various products that support need to expand capacity of existing facilities
Motorola	41.3	Manufactures wireless handsets, wireless data networks, digital and analog cellular telephone networks, wireless software and modules.

Note: Market capitalization downloaded from http://www.yahoo.com on Jan. 18, 1999.

As Table 1 shows, monopolization of the wireless equipment industry by wireless service firms would be next to impossible.

4. Given the Present Demand Conditions, a Single Alternative 10 MHz Carrier Could Accommodate Most of the Traffic

23. At present, digital PCS systems using CDMA technology—the most spectrally efficient technology available today—build their systems in units of capacity called "carriers." Each carrier requires approximately 2.5 MHz of spectrum. In addition, guard bands are required on both ends of the spectrum to prevent interference. Therefore, a PCS provider can build three carriers in a 10 MHz block of spectrum. Initially, each provider builds out a single carrier, but as subscribers and peak-period usage expand, a second carrier is installed. PCS providers using CDMA technology in the A and B blocks, which were auctioned in 1996, are only now beginning to install second carriers for use in 1999.[31] No wireless carrier has begun to deploy a third carrier, and few are expected to do so in the foreseeable future.

24. Suppose a single firm tried to monopolize a particular region by first gaining a large share of the available spectrum and then raising prices. Based on the aforementioned capacity of spectrum, one 10 MHz block of spectrum is sufficient to provide a wireless carrier with the ability to satisfy the current demand for wireless voice services. Thus, so long as there remained at least one 10 MHz carrier in the same region willing to match the old price of the larger firm, that smaller firm would be poised to absorb most of the larger firm's traffic due to

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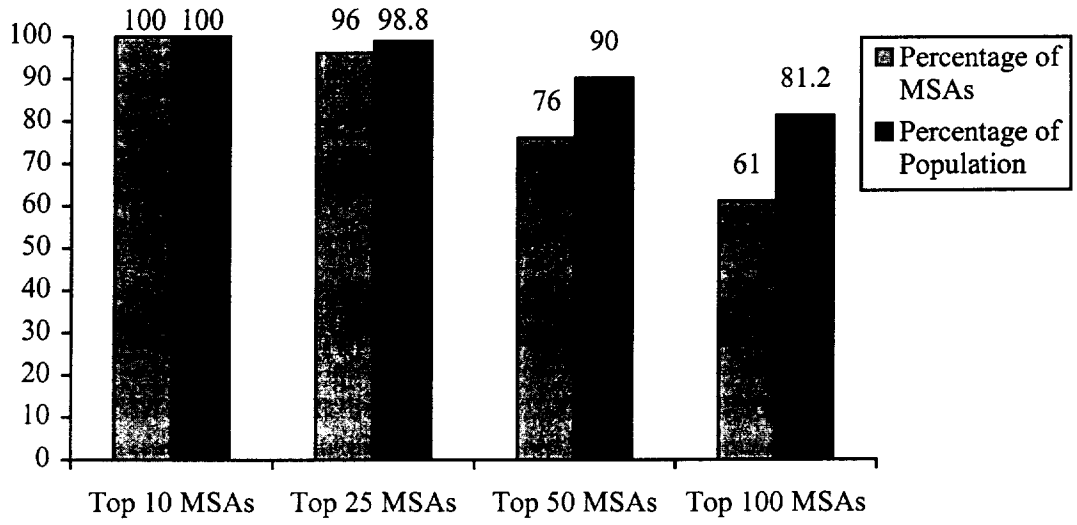
31. Sprint has begun to deploy second carriers in the largest metropolitan areas for use in early 1999. GTE and Bell Atlantic are considering such a deployment for 1999.

the technological capabilities of spectrum management. Recognizing the ability of a smaller rival to absorb its traffic, the large firm would not proceed with a price increase, as the expected payoff of high prices and no customer base would be less than the expected payoff with lower prices and its existing customer base.

25. Perhaps the best evidence that 10 MHz is sufficient spectrum to allow a firm to be competitive in the present wireless voice industry is the experience of Nextel. Operating with an average of 14 MHz of spectrum in each region (which, for technological reasons, is roughly equivalent to a 10 MHz PCS block of spectrum), Nextel has become a dynamic competitor, providing innovative services and leading in the development of a uniform nationwide pricing plan. As Figure 2 shows, Nextel now operates with systems that can reach 100 percent of the population in the ten largest 10 MSAs, 90 percent of the population in the fifty largest MSAs, and more than 81 percent of the population in the 100 largest MSAs.

FIGURE 2: MARKETS IN WHICH NEXTEL OPERATES



Source: *Based on an analysis of Paul Kagan & Associates data.*

26. The future viability of a 10 MHz carrier depends on the projected demand for wireless offerings. At very high levels of demand, a carrier with only 10 MHz of spectrum would have to invest more in additional equipment than a competitor in the same region with 20 MHz of spectrum. This tradeoff point, however, is well in excess of predicted penetration levels of roughly 40 percent over the next several years.[32] Therefore, one 10 MHz block of spectrum in the possession of a rival carrier is sufficient to deter any attempts at monopolization for several years to come.

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32. These forecasts are: Yankee Group (37.9 percent); Paul Kagan (41.4 percent); Strategis (42.9 percent); and Dennis Leibowitz of Donaldson, Lufkin, and Jenrette (38.9 percent).

5. Falling Entry Barriers Undermine the Ability to Monopolize or Collude

27. For several reasons, ease of entry undermines the ability of either a single firm to exert market power in wireless services or any group of firms successfully to collude to raise prices. First, to compete in the wireless industry, firms need spectrum, capital, and access to tower sites. Given the rapid advances in transmission technology, spectrum requirements for existing services are now much lower relative to the total amount of spectrum available. Moreover, the amount of spectrum potentially available to wireless competitors could increase beyond the current 180 MHz of cellular, PCS, and ESMR spectrum. For example, the lower eighty blocks of ESMR spectrum remain to be auctioned.[33] Second, to our knowledge, there is no evidence of capital market imperfections in the wireless industry. If there were any such imperfections, the Commission's generous bidding credits for designated entities would have compensated for any borrowing difficulties encountered by small firms.

28. Third, although the costs of building wireless systems to use the available spectrum are not small, technological progress is reducing the total cost of such systems. As Figure 3 shows, the incremental cost of building cell sites has declined steadily for almost a decade.

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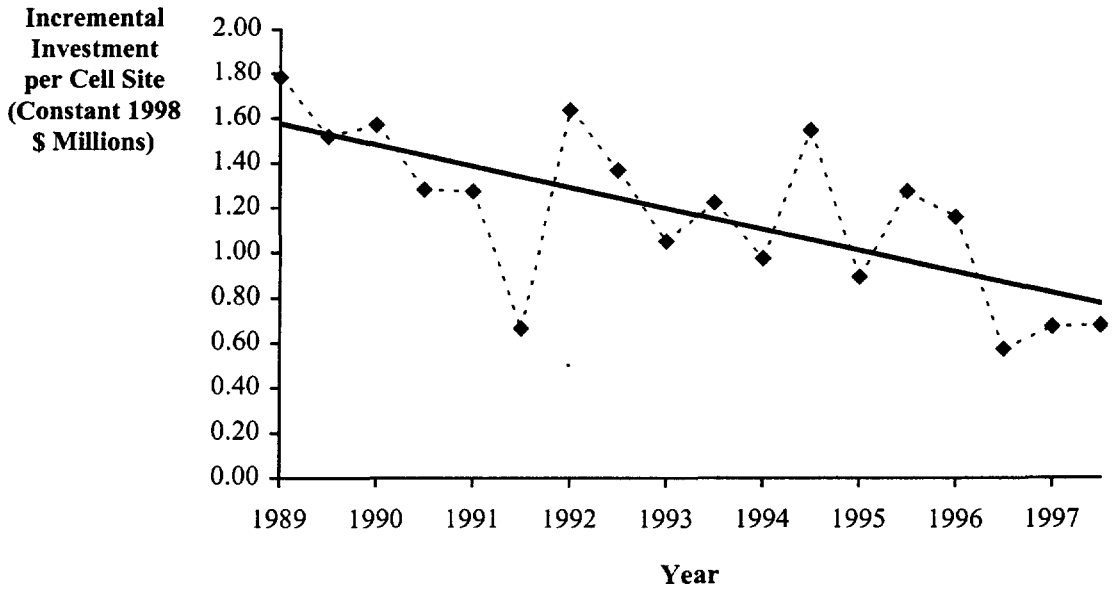
33. In phase I of the ESMR auctions, the Commission licensed the upper 200 blocks of ESMR spectrum. In phase II, the Commission will auction the lower 80 blocks. FEDERAL COMMUNICATIONS COMMISSION SPECIALIZED MOBILE RADIO (SMR): SMR UPPER 200 FACT SHEET, can be downloaded at http://www.fcc.gov/auctions.

FIGURE 3: INCREMENTAL COST OF BUILDING CELL SITES



Source: CTIA Semi-Annual Data Survey (June 1989-June 1998).

29. In addition, the cost of tower siting is becoming less of a barrier to entry. Independent tower management companies—such as American Tower, Omni America, Crown Castle, and TeleCom Towers—are becoming important suppliers of tower sites. As a result, entrants can lease these facilities rather than buy sites on their own. Independent cell site operators (ICOs) increase the overall availability of towers by permitting collocation on the same tower of rival operators, making the cell site management function more efficient.[34] ICOs

34. LEGG MASON WOOD WALKER, INDEPENDENT WIRELESS TOWER OPERATORS: REACHING NEW HEIGHTS 15 (fall 1998).

increase the availability of cell sites by removing the incentive of an incumbent carrier to refuse to deal with an entrant. As long as profits for site management continue to grow, one would expect ICOs to facilitate entry into the wireless business.[35] In conclusion, any carrier considering monopolization would have to recognize the competitive threat of potential entrants.

6. Durable Nature of Spectrum Renders Attempts at Monopolization Futile

30. For attempted monopolization of wireless services to be profitable, a wireless carrier would have to be able to raise prices above current market levels at some future date. Those price increases would have to be large enough to compensate the carrier for the profits forgone by holding prices at predatory levels to injure its remaining rivals. Even in the improbable event that a single carrier could drive one of its rivals into bankruptcy, the spectrum of that carrier would remain intact, ready for another firm to buy the capacity at a distress-sale price and immediately undercut the carrier's noncompetitive prices. Thus, the durable or long-lived nature of spectrum would serve as a powerful deterrent against any attempts at monopolization. In 1996 the Commission embraced, with respect to newly enacted section 272, the logic of such skepticism toward hypothesized ILEC predation directed toward interexchange carriers operating fiber-optic networks.[36] That conclusion accords with the findings of many

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35. For example, U.S. RealTel Inc., a Chicago-based firm that claims to be the nation's largest telecommunications properties landlord, collects between 25 and 35 percent of the rates that it negotiates for tenants. *See* Jon Van, *An Industry Sprouts from Rooftops: RealTel Handles Leasing of Building for Phone Companies' Antennas and Lines*, CHI. TRIB., Nov. 19, 1998, at B1.

36. Implementation of the Non-Accounting Safeguards of Sections 271 and 272 of the Communications Act of 1934, as Amended; and Regulatory Treatment of LEC Provision of Interexchange Services Originating in the LEC's Local Exchange Area, Notice of Proposed Rulemaking, CC Dkt. No. 96-149, 11 F.C.C. Rcd. 18,877, 18,943 ¶ 137 (1996) (citing Daniel F. Spulber, *Deregulating Telecommunications*, 12 YALE J. ON REG. 25, 60 (1995); other

respected regulatory economists.[37] If the argument is true for fiber capacity, then it holds with even greater force for a durable resource such as spectrum.

7. Warehousing of Spectrum Is Not a Feasible Means to Monopolize the Wireless Services Industry

31. Warehousing of spectrum is not a feasible means to monopolize the wireless services industry. As explained earlier, a single carrier could not expect to limit the capacity of its rivals by depriving them of one input in the production process. Second, and perhaps more importantly, warehousing of spectrum is not a profitable endeavor. Any resources devoted toward the hoarding of spectrum could not be deployed in other ventures. The opportunity costs of such behavior would be large, as firms could alternatively invest in such profitable ventures as mobile Internet access. In addition, any urge to warehouse spectrum would be outweighed by the desire to sell the asset for cash. Suppose a firm with 100 MHz of spectrum was considering the option of selling 10 MHz. To the extent that returns to spectrum were decreasing at such high levels, the usage value of the first 10 MHz of spectrum for a spectrum-constrained rival would far exceed the usage value for the warehousing carrier. Thus, to hoard spectrum would entail forgoing an immediate cash flow equal to the difference in private values. Moreover, the expense of acquiring spectrum to warehouse is one that the firm incurs immediately, whereas the benefit

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citations omitted).

37. *E.g.*, PAUL W. MACAVOY, THE FAILURE OF ANTITRUST AND REGULATION TO ESTABLISH COMPETITION IN LONG-DISTANCE TELEPHONE SERVICES 186–90 (MIT Press & AEI Press 1996); Susan Gates, Paul Milgrom & John Roberts, *Deterring Predation in Telecommunications: Are Line-of-Business Restraints Needed?*, 16 MANAGERIAL & DECISION ECON. 427 (1995); Paul S. Brandon & Richard L. Schmalensee, *The Benefits of Releasing the Bell Companies from the Interexchange Restrictions*, 16 MANAGERIAL & DECISION ECON. 349 (1995); Jerry A. Hausman, *Competition in Long-Distance and Telecommunications Markets: Effects of the MFJ*, 16 MANAGERIAL & DECISION ECON. 365 (1995); Kenneth J. Arrow, Dennis W. Carlton & Hal S. Sider, *The Competitive Effects of Line-of-Business Restrictions in Telecommunications*, 16 MANAGERIAL & DECISION ECON. 301 (1995).

to the firm (if any) of reduced competition occurs over a number of future periods. Consequently, that stream of anticompetitive benefits must be discounted at the firm's cost of capital to produce a present value that can be compared with the immediate outlay necessary to buy the spectrum to be warehoused. Thus, in addition to being sensitive to all the technological factors that will make spectrum relatively more abundant and capacious in the future, the feasibility of the spectrum warehousing strategy will be sensitive to all the factors that influence the firm's cost of capital. In conclusion, it is unlikely that any firm would attempt to monopolize the wireless industry through warehousing spectrum.

B. The Consumer Welfare Losses Associated with the Commission's Failure to Deter a Single Carrier, or a Group of Carriers Acting Collusively, from Exercising Market Power Would Be Transitory and Small

32. It is possible to measure the cost of a Type I error—in the unlikely event that is occurs—by estimating the loss in consumer welfare due to higher prices. Assuming that it offers the same price to all customers, the monopolist will always charge higher prices and produce less output relative to a competitive equilibrium.[38] Monopolization causes consumer surplus—the difference between what consumer would be willing to pay and what they actually pay—to fall in two ways. First, by charging higher prices, monopolization reduces consumer surplus by an amount equal to the product of the change in price and the output under monopoly.[39] Second, by

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38. *See, e.g.,* HAL R. VARIAN, MICROECONOMIC ANALYSIS 283-39 (W. W. Norton & Co., 3rd ed. 1992). A price discriminating monopolist will produce the same amount of output as a competitive industry. Thus allocative efficiency is achieved, but the monopolist captures the entire consumer surplus.

39. This component of the loss in consumer welfare is entirely appropriated by the monopolist. Thus one might argue that it should not be included in a social welfare loss calculation.

restricting output, monopolization yields a deadweight loss by an amount equal to the area under the demand curve with length equal to the difference in output level between the monopoly and competitive equilibrium.

33. An estimation of the loss of consumer surplus requires estimates of the demand curve and the price charged by a hypothetical monopolist. Professor Jerry Hausman of the Massachusetts Institute of Technology has estimated the slope of the industry demand curve for cellular services and has found the own-price elasticity of demand to be -0.41.[40] Using this estimate as a proxy for the elasticity of demand for cellular and PCS services, the monopolist's reduction in output can be measured by solving the formula:

$$\eta = \frac{(Q_M - Q_C)/Q_C}{(P_M - P_C)/P_C} = -0.41,$$

where η is the own-price elasticity of demand for cellular and PCS services; Q_M and Q_C are the numbers of subscribers under the monopoly equilibrium and the perfectly competitive equilibrium, respectively; and P_M and P_C are the prices of wireless services under the monopoly equilibrium and the perfectly competitive equilibrium, respectively.

34. Based on the above formula, it is possible to calculate the loss in consumer welfare associated with various price increases by a hypothetical monopolist. Even in a scenario in which the hypothetical monopolist raises prices substantially, the short-term loss in consumer

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40. Jerry Hausman, *Valuation and the Effect of Regulation on New Services in Telecommunications*, Conference Paper, Pricing and Costing a Competitive Local Telecommunications Network, American Enterprise Institute, Nov. 4, 1997. To estimate the model, Professor Hausman collected price and subscribership data for the

welfare appropriated by the monopolist would not be large. The portion of consumer welfare that represents the deadweight loss would be substantially less.

35. More importantly, the *expected* loss in consumer welfare would be miniscule, as any welfare loss must be multiplied by the probability of the Type I error. For example, suppose the loss in consumer welfare is estimated to be L and the probability of the Type I error is estimated to be 0.1 percent. Hence, the expected loss would be $L/1000$. Stated another way, even a $1 million loss in consumer welfare would be converted into only a $1,000 expected loss. We believe that the probability of a Type I error would be vanishingly small because any aggregation of spectrum licenses would necessitate that an application for transfer of control first be filed with the Commission for its public interest review. Moreover, if the acquisition were sufficiently large, the parties would be forced to give pre-merger notification to the Federal Trade Commission and the Antitrust Division for their separate antitrust review under the Hart-Scott-Rodino process. These two reviews, under separate standards, would make it virtually certain that any harmful aggregation of spectrum would be detected before it could be accomplished.

36. Furthermore, we believe the losses (if any) from a Type I error would be transitory due to regulatory action and market forces. Market forces would drive the industry in the direction of competition. The existence of monopoly rents combined with the low entry barriers described above would induce rival firms to offer service in the region at lower prices.

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period 1989-93 from a confidential survey of cellular operators.

C. The Enforcement Costs Associated with the Commission's Failure to Deter a Single Carrier, or a Group of Carriers Acting Collusively, from Exercising Market Power Would Be Small

37. The Commission's elimination of the 45 MHz spectrum cap for CMRS would not mean that providers of wireless services would be free to hoard spectrum for anticompetitive purposes. The antitrust laws would obviously still be enforced, just as the Department of Justice has previously done in the numerous cases in which that agency has been called upon to scrutinize competition in the wireless industry.[41] Under the Sherman and Clayton Acts, individuals are subject to imprisonment and substantial fines, and corporations are subject to even higher fines.[42] Moreover, the Department of Justice is obviously not alone in its enforcement of the antitrust laws. Private plaintiffs may sue for treble damages,[43] the deterrent effect of which has long been recognized.[44] Finally, injunctive relief is available to correct anticompetitive conduct.[45] In light of these multiple waves of antitrust defense, it is unnecessary for the Commission to defend consumer welfare by prospectively prescribing, through retention of the 45 MHz CMRS spectrum cap, the market structure for wireless communications.

38. It bears emphasis, however, that even the antitrust laws are a default safeguard against any wireless service provider seeking to monopolize the market or any group of firms

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41. *See* Proposed Final Judgment and Competitive Impact Statement; United States of America v. AT&T Corp. and McCaw Cellular Communications, Inc.59 FR44158, Aug. 26, 1994

42. 15 U.S.C. §§ 1, 2.

43. *Id.* § 15.

44. *See, e.g.*, Michael K. Block, Frederick C. Nold & J. Gregory Sidak, *The Deterrent Effect of Antitrust Enforcement*, 89 J. POL. ECON. 429 (1981); Michael K. Block, & J. Gregory Sidak, *The Cost of Antitrust Deterrence: Why Not Hang a Price Fixer Now and Then?*, 68 GEO. L.J. 1131 (1980); J. Gregory Sidak, Note, *Rethinking Antitrust Damages*, 33 STAN. L. REV. 329 (1981).

seeking to cartelize it. The *first* line of defense against anticompetitive conduct is always the retributive threat of competition itself—from the many large, capable firms that currently provide, or soon will provide, wireless services. Those many firms—which may soon include a major, new entrant from abroad, Vodafone[46]—are not wallflowers. They have significant financial resources, managerial capabilities, as well as brand recognition and reputation.

39. To summarize, the expected cost of removing the cap are small. The expected cost of removing the cap equals the product of (1) the probability of a large carrier or a cartel of carriers will exert market power within a particular region (that is, the probability of the Type I error) and (2) the sum of the associated loss in consumer welfare and the enforcement costs of remedying that loss (that is, the costs of the Type I error). We have demonstrated qualitatively that the probability of the Type I error is near zero and the associated costs of the Type I error are transitory and small. We next turn to qualitative assessment of the Type II error, or the efficiency loss that may occur if the minimum efficient scale for some firms exceeds the 45 MHz allowed by the spectrum cap.

III. The Expected Costs of Retaining the Spectrum Cap Are Substantial

40. Suppose that the future demand for wireless services outstripped the supply capabilities for any single carrier with 45 MHz because of growth in demand for bundled service offerings of voice and data. In that circumstance, some firms might optimally choose to use more than 45 MHz of spectrum to satisfy consumer demand. In this section, we explore the magnitude

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45. 15 U.S.C. § 26.
46. See Laura M Holson, *British Carrier Wins Battle for AirTouch, Bell Atlantic Loses Out To a $60 Billion*

and severity of the errors that may occur if the Commission interferes with the optimal choice of spectrum by preventing spectrum acquisition over 45 MHz.

A. There Is a Nontrivial Probability that the Minimum Efficient Scale for Some Firms Exceeds the Cap

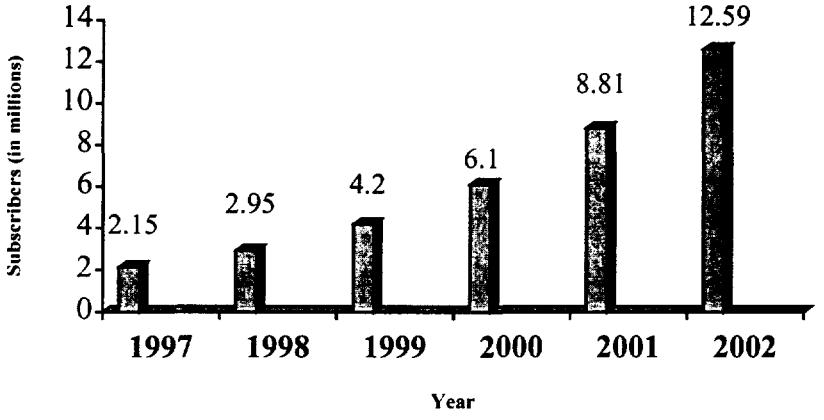
41. The minimum efficient scale for some firms may exceed the cap due to wireless consumers' increasing demand for bundled offerings of voice and data. According to a recent poll conducted by the Yankee Group, 15 percent of wireless users are very interested in mobile data services, and 36 percent are somewhat interested.[47] Figure 4 shows the forecasted growth in demand for wireless data services. Under their most conservative estimates, the Yankee Group forecasts that the market may grow to 12.59 million users by 2002.[48]

Offer, N.Y. TIMES, Jan. 16, 1999, at B1.

47. The Yankee Group, Mobile User Survey Series: *The Convergence of Mobile Data and Computing* (Aug. 1998), can be downloaded at http://research.yankeegroup.com/.

48. *Id.*

FIGURE 4: U.S. MOBILE DATA MARKET FORECAST



Source: Information downloaded from Yankee Group website at http://research.yankeegroup.com on January 19, 1999.

42. Many industry analysts expect a convergence of voice and data services over wireless platforms. The principal analyst in the mobile and satellite group at Ovum Inc. recently stated that "data is an integral component of the [third generation wireless] vision and will provide a massive expansion of the wireless data opportunity."[49] The Strategis Group predicts wireless Internet and email will become the "killer apps" of the next century.[50] In a 1998 survey, the Strategis Group found that 30 percent of the respondents expressed interest in a "small

49. *Wireless Industry Roundtable Discussion On The Table: The Year in Review And A Look Forward To The Future Of Wireless Data*, WIRELESS DATA NEWS, Dec. 9, 1998 (remarks of John Davison).

50. The Strategis Group, *Wireless Internet and E-mail Markets: 1998*, at 1 (downloaded from website at http://www/strategisgroup.com on Jan. 19, 1999)

wireless device that could send and receive e-mail."[51] Another 35 percent were interested in receiving wireless email services over devices "similar to a cellular phone or pager."[52] This is powerful evidence of a growing demand for bundled wireless offerings of voice and data using new third generation (3G) technology.

43. There is also evidence that wireless carriers and equipment makers are responding to this demand. BellSouth Wireless recently added data services to its wireless service offerings.[53] Wireless equipment manufacturers previously designed voice and data networks under two distinct architectures. Recently, however, telecommunications equipment companies such as Lucent have begun to unite the architectures in anticipation of the convergence between voice and data.[54]

44. In light of consumers' demand for bundled offerings, the optimal scale of spectrum capacity for some wireless firms may exceed the spectrum cap. We next examine how cost-minimizing firms make optimal input selections and analyze how the 45 MHz spectrum cap may interfere with those decisions.

B. The Social Costs Associated with the Commission's Failure to Allow At Least One Carrier to Use More Than 45 MHz of Spectrum Would Be Substantial

45. The Cellular Telephone Industry Association (CTIA) recently described the 45

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51. *Id.*
52. *Id.*
53. *Wireless Industry Roundtable Discussion On The Table: The Year in Review And A Look Forward To The Future Of Wireless Data*, WIRELESS DATA NEWS, Dec. 9, 1998 (remarks of Fran Frith).
54. Lucent Technologies Press Release, *Lucent Technologies number one in wireless office*, downloaded from Lucent website at http://www.lucent.com on Jan. 20, 1997.

MHz spectrum cap as "an impediment to the efficient use of spectrum and the introduction of new services."[55] We describe here three kinds of efficiency losses that would likely arise from continuation of the cap. First, the spectrum cap may produce a misallocation of carriers' resources across equipment and spectrum. Second, future competitive alliances may be based more on complying with the Commission's spectrum cap than on maximizing potential synergies. Third, the spectrum cap may deny consumers lower wireless prices that would flow from firms' achieving economies of scale and scope in the delivery of wireless services.

1. Misallocation of Resources Across Equipment and Spectrum

46. An artificial regulatory constraint on spectrum capacity can induce a misallocation of resources across equipment and spectrum. Figure 5 depicts the input choices available to a wireless carrier seeking to minimize total costs.

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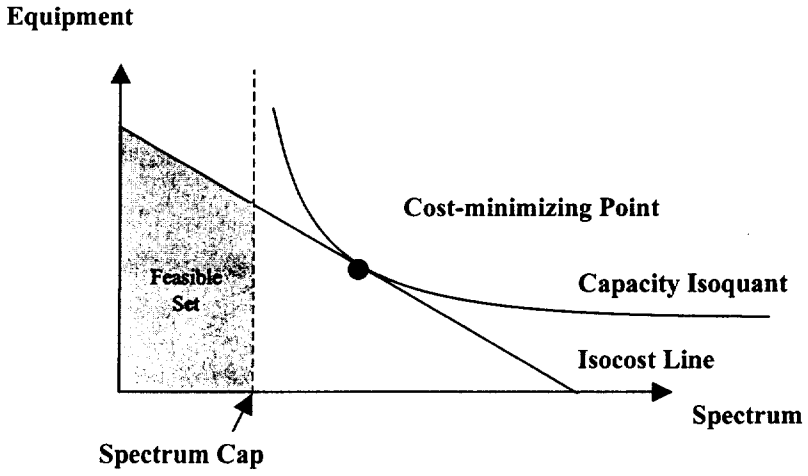
55. *CTIA Faults FCC Wireless Policies as Anticompetitive*, MOBILE COMM. REP., Jan. 11, 1999.

FIGURE 5: OPTIMAL ALLOCATION OF EQUIPMENT
AND SPECTRUM FOR A COST MINIMIZING FIRM



The curved labeled *isoquant* represents all the combinations of spectrum and equipment that would yield the same level of capacity for the firm. The line labeled *isocost* represents all combinations of spectrum and equipment that would yield the same level of total expenditures for the firm. A cost-minimizing firm chooses to combine the inputs in such a way that the ratio of input prices equals the ratio of marginal factor productivities. Geometrically, this is equivalent to finding the point of tangency between the isocost and isoquant. As Figure 7 shows, a firm facing this particular technological tradeoff and these particular input prices would naturally choose more spectrum than the Commission's cap allows. Any deviation from the optimal, cost-minimizing point represents a loss in productive efficiency. Due to the constraint imposed by the cap, a firm could achieve a greater amount of capacity while not increasing its total expenditures by substituting away from equipment, that is, by trading equipment for spectrum at the current level of input prices.

2. Distortions in the Optimal Scope and Scale of the Firm

47. There are likely great economies of scale and scope in the provision of advanced mobile data services. First of all, high-speed data services will likely consume large amounts of raw spectrum bandwidth. The required throughput is higher to begin with, and compression is less effective on data streams (which are likely to be already compressed at their source) than it is on the pattern-rich human voice. Second, offering a high-speed data capability is likely to be an all-or-nothing decision. That is, there may be no such thing as a minimal data offering. If a carrier were not to offer high-speed data at an intensive scale throughout a particular market region, it would likely suffer the same fate of the current data protocols, which have struggled to gain user acceptance and build sufficient penetration to justify the necessary investment.

48. Second, there are likely great economies of scope between the provision of advanced data services and traditional voice-grade services over the same wireless network. The data services would likely share the same towers and other structures (for example, power supply housings), the same backhaul transport routes, and potentially the same antennas. Operators could then achieve other economies of scope by marketing and billing these two types of services jointly. Therefore, the development of advanced data services could lower the costs of providing traditional voice-grade mobile service.

49. Although we do not know now what the optimal spectrum bandwidth will be for the provision of advanced wireless data services, it may well be far in excess of the current 45 MHz spectrum cap. One can envision the need for greater raw bandwidth using a simple calculation. Suppose that an operator can satisfy future voice demand with 10 MHz of spectrum. If 20 percent of the operator's customers demanded mobile high-speed data with a 384 kbps

average throughput (twenty times the current voice-rate throughput), as a rough approximation the raw bandwidth required would need to increase to 480 percent of the original, or 48 MHz = (.20 x 20 + .80 x 1) x 10 MHz. Even more bandwidth would be required if customers were demanding mobile T1 equivalents (with a data rate of 1.5 Mbps).

3. The Spectrum Cap May Retard Investment and Innovation

50. The Commission desires that its policy toward the CMRS spectrum cap "promotes, rather than impedes, the introduction of innovative services and technological advances."[56] Unfortunately, the spectrum cap may retard investment and innovation through myriad effects. First, wireless service providers must compete with other industries for capital. To the extent that the spectrum cap prohibits wireless carriers from operating in the most efficient manner, investors will commit their capital elsewhere. Second, the cap may lead companies to delay entry. If the minimum efficient scale exceeds the cap, potential carriers may strategically delay entry until the cap is lifted. Third, the cap may inhibit exit from the wireless industry. With the cap in place, a 30 MHz firm may be forced to find two or more buyers, as the potential acquirer may be close to the cap itself. Future entrants would rationally anticipate the "exit problem" and would therefore be less willing to enter and invest ex ante.[57]

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56. *NPRM, supra* note 2, at ¶ 5.

57. It is well recognized that a barrier to exit becomes a barrier to entry. *See* WILLIAM J. BAUMOL, JOHN C. PANZAR & ROBERT D. WILLIG, CONTESTABLE MARKETS AND THE THEORY OF INDUSTRY STRUCTURE 6-7 (Harcourt Brace Jovanovich, rev. ed. 1988).

C. The Enforcement Costs Associated with the Commission's Failure to Allow At Least One Carrier to Use More Than 45 MHz of Spectrum Would Be Large

51. If the 45 MHz spectrum cap becomes a binding constraint on carriers' optimal spectrum utilization, the equilibrium scale of carriers in the face of the cap will be less than socially optimal. Barring the removal of the spectrum cap, the Commission would be forced into the undesirable position of conducting a separate wireless data services auction. This option would entail substantial transactions costs (such as determining which portion of spectrum to sell, conducting bidder seminars, and conducting the auction) and directly contradict the Commission's prior objective of not dictating how spectrum should be used. In addition, the artificial bifurcation of wireless voice and data delivery would deprive consumers of the potential savings that could be realized if carriers could offer voice and data over the same spectrum. Retention of the spectrum cap would also entail administrative costs tied directly to compliance with the cap. These costs would include costs imposed on a carrier in attempting to determine compliance and, in the event of an inability to comply under its business plans, formulation of alternatives. The Commission would incur corresponding administrative costs.

CONCLUSION

52. We can envision either of two alternative scenarios developing in the wireless service industry, each of which would require the abolition of the spectrum cap. First, the wireless market could divide into various niches, with some firms serving voice only, data only,

business only, or some combination of the three.[58] Second, the demand for bundled services could be so strong that the only way for a firm to compete effectively would be to aggregate more than 45 MHz of spectrum.

53. In the first scenario, where the industry split apart into various niche offerings, 45 MHz would be insufficient for the subset of firms wishing to provide bundled services or to invade the fixed-services market. A single 10 MHz carrier providing voice services alone could still provide the pricing discipline necessary to defeat any attempt at monopolization by a multiproduct firm or any attempt at cartelization by multiple firms. The marginal customer would abandon the bundle of services in the face of excessive prices because, for that customer, the voice-only applications would be substitutes for those bundled services.

54. In the second scenario, where the demand for bundled services overwhelms, all firms would require more than 45 MHz to supply services efficiently. Hence, a single 10 MHz carrier could not exert pricing discipline in the face of attempted monopolization or cartelization. But in this second scenario, the Commission's entire regulatory framework for CMRS spectrum would rest on the misconception that the 45 MHz spectrum cap was not a binding constraint on the efficient production of wireless services. Confronted with that erroneous premise, the Commission would need to allocate additional spectrum so that multiple firms could efficiently produce services under the new competitive paradigm. Thus, under either scenario, the

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58. This phenomenon may already be occurring. For example, Cellular One does not appear to be following the same pricing strategies of its competitors in the Washington, D.C. area. Rather than reducing prices across for all levels of usage, Cellular One is offering additional lines for family members with free weekend airtime. Perhaps

Commission would be better served by removing the cap.

55. Regardless of whether some or all firms would optimally choose to employ more than 45 MHz, the Commission's retention of the 45 MHz spectrum cap would thwart one of the principal functions served by market forces—namely, to produce and reveal information. As one of us has previously observed:

> Competition is the best mechanism for stimulating research and development and for resolving uncertainty about evolving technology. Technological change and uncertainty surely characterize the telecommunications industry. As Friedrich A. Hayek powerfully argued, markets create and process vast quantities of information, which necessarily would overwhelm the conscious efforts of any central economic planner.[59]

In the event that the spectrum cap is eliminated and a Type I error occurs, the Commission at least becomes aware of the problem and can take steps to remedy the harm to the public interest. In contrast, in the event that the spectrum cap is retained and a Type II error occurs, it is possible that the Commission would never learn that it was preventing the optimal input selection of wireless firms. Such information is extremely valuable for the Commission to have at its disposal, as it would assist the agency in redefining its spectrum allocation policy in the manner most conducive to the public interest.

56. The goal for which the Commission devised the 45 MHz CMRS spectrum cap has been achieved. The cap should now be abolished. The expected cost of removing the cap is the product of (1) the probability that a single carrier, or a group of carriers acting collusively, could

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this strategy is an indication that the wireless market will segment into business and family usage.

59. J. GREGORY SIDAK & DANIEL F. SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT: THE COMPETITIVE TRANSFORMATION OF NETWORK INDUSTRIES IN THE UNITED STATES 523 (Cambridge University

exercise market power and (2) the sum of the associated loss in consumer welfare and the enforcement costs of remedying the loss. The expected cost of keeping the spectrum cap is the product of (1) the probability that the minimum efficient scale for at least one firm exceeds the spectrum cap and (2) the sum of the efficiency losses and the enforcement costs of remedying those efficiency losses. Our conclusion is grounded in competitive analysis and decision theory, and it is consistent with the Commission's belief that "trusting in the operation of market forces generally better serves the public interest than regulation."[60] The probability that a single carrier, or a group of carriers acting collusively, could exercise market power in a given geographic region is remote, while the corresponding harms are relatively minor. Meanwhile, the probability that the minimum efficient scale for at least one firm exceeds the spectrum cap is nontrivial, and the resulting loss in efficiency is potentially large. Thus, the Commission would advance the public interest by abolishing the cap, because the expected costs of retaining the cap exceed the expected costs of removing it.

Press 1997) (citing Friedrich A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519 (1945)).

60. *NPRM*, *supra* note 2, at ¶ 5.

QUALIFICATIONS

57. My name is J. Gregory Sidak. I am the F. K. Weyerhaeuser Fellow in Law and Economics at the American Enterprise Institute for Public Policy Research (AEI) in Washington, D.C., where for the past seven years I have directed AEI's Studies in Telecommunications Deregulation. I am also a senior lecturer at the Yale School of Management, where I teach a course on telecommunications regulation and strategy with Professor Paul W. MacAvoy. In addition to holding these two academic positions, I am a Principal in LECG, Inc. (the Law & Economics Consulting Group), an economic consulting services firm that provides economic and financial analysis, expert testimony, litigation support, and strategic management consulting to a broad range of public and private enterprises.

58. I have worked in the federal government on three occasions. From 1987 to 1989, I was Deputy General Counsel of the Federal Communications Commission. From 1986 to 1987, I was Senior Counsel and Economist to the Council of Economic Advisers in the Executive Office of the President. From 1981 to 1982, I served as a law clerk to Chief Judge Richard A. Posner during his first term on the U.S. Court of Appeals for the Seventh Circuit. In addition to having worked in government, I have previously worked, as an attorney in private practice, on numerous antitrust cases and federal administrative, legislative, and appellate matters concerning telecommunications and other regulated industries.

59. My academic research concerns regulation and strategy in telecommunications and other network industries, antitrust policy, and constitutional law issues concerning economic regulation. I have written four books concerning pricing, costing, competition, and investment in regulated network industries: *Deregulatory Takings and the Regulatory Contract: The*

Competitive Transformation of Network Industries in the United States (Cambridge University Press 1997), co-authored with Daniel F. Spulber; *Toward Competition in Local Telephony* (MIT Press & AEI Press 1994), co-authored with William J. Baumol; *Transmission Pricing and Stranded Costs in the Electric Power Industry* (AEI Press 1995), also co-authored with Professor Baumol; and *Protecting Competition from the Postal Monopoly* (AEI Press 1996), also co-authored with Professor Spulber. I am also the author of a fifth book, *Foreign Investment in American Telecommunications* (University of Chicago Press 1997), and of more than thirty scholarly articles in the *California Law Review, Columbia Law Review, Cornell Law Review, Duke Law Journal, Georgetown Law Journal, Harvard Journal on Law & Public Policy, Industrial and Corporate Change, Journal of Political Economy, New York University Law Review, Northwestern University Law Review, Southern California Law Review, Stanford Law Review, Yale Journal on Regulation*, and elsewhere. I am the editor of four books: *Telecommunications Deregulation in Germany and the United States* (AEI Press, forthcoming 1999); *Competition in International Telecommunications* (AEI Press, forthcoming 1999); *Is the Telecommunications Act of 1996 Broken? (If So, How Can We Fix It?)* (AEI Press, forthcoming 1999); and *Governing the Postal Service* (AEI Press 1994). I have testified before the U.S. Senate and House of Representatives, and my writings have been cited by the Supreme Court of the United States, by the lower federal and state supreme courts, and by state and federal regulatory commissions.

60. I have been a consultant on regulatory and antitrust matters to the Antitrust Division of the U.S. Department of Justice, to the Canadian Competition Bureau, and to more than thirty companies in the telecommunications, electric power, natural gas, mail delivery,

broadcasting, newspaper publishing, and computer software industries in North America, Europe, Asia, and Australia.

61. From Stanford University, I earned A.B. (1977) and A.M. (1981) degrees in economics and a J.D. (1981) in law. I was a member of the *Stanford Law Review.*

62. My name is David J. Teece. I am Mitsubishi Bank Professor, Haas School of Business, and Director, Institute for Management, Innovation and Organization, University of California at Berkeley, and a Principal at LECG, Inc. I have been a full professor at Berkeley since 1982. Before that, I was Assistant and then Associate Professor of Business Economics at the Graduate School of Business, Stanford University. I received my Ph.D. in Economics from the University of Pennsylvania in 1975. As an industrial organization economist, I have studied the economics of technological change, competition policy, and business strategy issues for over two decades.

63. At U.C. Berkeley, I was the Co-founder of the Management of Technology Program, a joint program between the School of Business and College of Engineering, and the Consortium on Competitiveness and Cooperation, a multi-campus research program linking scholars at Berkeley, Stanford, Columbia, Harvard, and Wharton who have deep and enduring interests in the long-run performance of the United States in the global economy. I am also Chairman of the Consortium for Research on Telecommunications Policy Program, a multi-campus research group with active nodes at U.C. Berkeley, the University of Michigan, and Northwestern University.

64. My research has been centrally concerned with the relationship between the structure of firms (especially the scope of their activities) and their performance, particularly the

capacity to develop and introduce new technologies. I have had a special interest in innovation, organizational structure, and antitrust. I have testified before Congress on regulatory policy and competition policy and am the author or co-author of over one-hundred books and scholarly articles. Relevant books include *Strategy, Technology, and Public Policy* (Edward Elgar Publishing 1998); *Fundamental Issues in Strategy* (Harvard Business School Press 1994, with Richard P. Rumelt); *Antitrust, Innovation, and Competitiveness* (Oxford University Press 1992, with Thomas M. Jorde); and *The Competitive Challenge: Strategies for Industrial Innovation and Renewal* (1987). Relevant papers include "Competition and Cooperation: Striking the Right Balance," *California Management Review* (Spring 1984, with Thomas M. Jorde); "Telecommunications in Transition: Unbundling, Reintegration, and Competition," *Michigan Telecommunications and Technology Law Review*, 4 (1995); and "Competition and Unbundling in Local Telecommunications: Implications for Antitrust Policy" (with Robert G. Harris and Gregory L. Rosston), published in *Towards a Competitive Telecommunications Industry: Selected Papers from the 1994 Telecommunications Research Conference* (Gerald Brock, ed., Lawrence Erlbaum Associates 1995). I am also the founding editor of the journal *Industrial and Corporate Change*, published by the Oxford University Press.

65. Throughout the 1980s and 1990s, I have provided expert testimony on numerous occasions to the FCC, other state and federal regulatory agencies, the federal courts, and foreign regulatory bodies and courts on the competitive and strategic implications of regulatory and antitrust proceedings concerning both wireline and wireless telecommunications. For example, I submitted testimony on behalf of AT&T in the divestiture case, *United States v. AT&T Corporation*; on behalf of Ameritech in support of its Customers First Plan; and, most recently, on

behalf of Bell Atlantic and GTE in support of their proposed merger.

66. We file this declaration in our individual capacities, and not on behalf of the American Enterprise Institute, the Yale School of Management, or the University of California.

I declare, under penalty of perjury, that the foregoing is true and correct, to the best of my knowledge and belief. Executed on January 25th, 1999.

J. Gregory Sidak

I declare, under penalty of perjury, that the foregoing is true and correct, to the best of my knowledge and belief. Executed on January 20th, 1999.

David J. Teece

David J. Teece